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(54) Fibre composition

(57) A glass composition, for use in forming reinforcing fibres, comprises by weight, 38 to 46% silica, 8 to 15% aluminium oxide, 15 to 30% calcium oxide, 1 to 8% zirconium oxide, 0 to 10% magnesium oxide, 4 to 11% iron as Fe_2O_3 , and 2 to 6% R_2O , where R represents sodium, potassium or lithium, the balance, if any, consisting of compatible constituents. There is also provided a process for producing alkali-resistant glass fibres wherein a melt is produced from a mixture containing basalt rock, a calcium-containing compound and a zirconium-containing compound, and the melt is blown or spun into fibres.

SPECIFICATION

Fibre composition

- 5 This invention relates to a composition which may be used to produce alkali-resistant glass fibres, to fibres produced therefrom, and to the use of such fibres for reinforcing moulded articles.
- It has been conventional to reinforce such
- 10 moulded articles as building boards made, for example, from materials containing calcium silicate, gypsum and/or cement, with inorganic fibres such as glass fibres and asbestos fibres. Asbestos fibres have been particularly useful, in view of their considerable resistance to attack by alkaline materials such as those forming the matrix in which they are dispersed in moulded articles. This advantage of asbestos is offset, however, by environmental disadvantages, since recently the fine dust produced
- 20 during the processing of asbestos fibres or materials containing asbestos fibres has been considered to constitute a health hazard.
- Industry has therefore been searching in recent years for an inorganic fibre which can be used as a
- 25 reinforcing fibre in place of asbestos, and which has similar qualities so far as resistance to attack by alkaline materials is concerned. Many compositions for the production of alkali-resistant glass fibres have been proposed in the patent literature.
- 30 According to the present invention a glass composition suitable for the formation of alkali-resistant glass fibres comprises, by weight, 38 to 46% silica, 8 to 15% aluminium oxide, 15 to 30%, preferably 20 to 30%, calcium oxide, 1 to 8%, preferably 5 to 8%, zirconium oxide, 0 to 10% magnesium oxide, 4 to 11% iron as F_2O_3 , and 2 to 6% R_2O , where R represents sodium, potassium or lithium, the balance, if any, consisting of compatible constituents.
- Further according to the invention, a process for
- 40 producing alkali-resistant glass fibres comprises forming a mixture containing basalt rock, a calcium-containing compound and a zirconium-containing compound, producing a melt from such mixture and blowing or spinning the melt into fibres.
- 45 The fibres are made from a raw material mix comprising a basalt rock, which preferably had a silica content greater than 44% by weight, and most preferably of the order of 55% by weight, a zirconium-containing mineral which may suitably be zircon or
- 50 zirconia, and a calcium-containing compound, preferably limestone, hydrated or slaked lime, quicklime or calcium carbonate, e.g. chalk. Calcium-containing waste products from other processes may also be used.
- 55 The basalt rock is preferably a fine-grained basalt of the olivine type, and particularly preferred basalts are the olivine tholeiites and the teschenitic olivine dolerites. Any basalt rock may be used, however, so long as it can be melted in a furnace and produces, in
- 60 admixture with the zirconium- and calcium-containing compounds, a glass composition within the definition given above. Most basalts contain titanium dioxide, and some contain phosphorus pentoxide and tri-manganese tetroxide, and these
- 65 compounds are therefore the most likely to represent

ent the balance of the ingredients using the raw materials described above.

- In a preferred method of fibre manufacture, the raw materials will be charged into a furnace and melted. The molten glass will then flow into a forehearth from which it passes through metal bushings containing a large number of small holes. The individual streams of melt emanating from the holes are then attenuated into fibres by blowing with high
- 70 pressure steam or air.

- The furnace may be an electric furnace, or a gas- or oil-fired furnace, the latter being preferred. It may also be a coke-fired furnace, i.e. a coke-fired cupola furnace, and one advantage of this type of furnace is
- 80 that it enables practically any form of basalt to be used.

- For efficient fibre production, the melt preferably has a viscosity of 8 to 50 poises at 1400°C, preferably from 12 to 30 poises at 1400°C. Fibres produced by a
- 85 blowing technique are normally found to be of random length and of a wool-like appearance, resembling for example rock wool. They may if desired be processed after blowing to give them a more uniform length, suitable to the use to which they are to be put. For example, when they are to be used in the manufacture of reinforced Portland cement boards they may suitably be processed to have a mean fibre length in the range 12 to 15 mms.

- Fibres produced in accordance with this invention
- 95 show good durability and alkali-resistance properties, and are useful as reinforcing materials in the production of moulded articles from such binder materials as calcium silicate binders, gypsum plaster binders and cement, e.g. Portland cement, binders.
- 100 The alkali-resistant glass fibres of the present invention may be used in such reinforced moulded articles in generally similar proportions to those in which glass and asbestos fibres have hitherto been used.

- The present invention thus provides glass fibres
- 105 which are resistant to alkaline attack and which may be produced cheaply and quickly, using equipment which is already in existence for the production, for example, of mineral wool fibres.

- The following Examples are given for the purpose
- 110 of illustrating the invention.

EXAMPLE 1

- A raw material batch comprising 60 parts by weight basalt "A", 40 parts by weight limestone and 7.9 parts by weight zircon was charged into an oil-
- 115 fired furnace (at 1400°C) and melted. The molten glass flowed from the furnace chamber into a forehearth and thence through metal bushings (at 1200-1250°C) containing many small holes. The streams of melt issuing from the holes were attenuated into fibres by blowing with high pressure
- 120 steam.

The basalt "A" had the following composition, in weight percent:-

125	SiO ₂	55.31
	Al ₂ O ₃	14.14
	Fe ₂ O ₃	6.79
	FeO	5.49
	MgO	3.00
130	CaO	5.94

TiO ₂	2.57
K ₂ O	2.59
Na ₂ O	4.12

- 5 The glass produced had the following oxide composition in weight percent:—

	SiO ₂	40.05
	Al ₂ O ₃	9.50
10	Fe ₂ O ₃	4.15
	FeO	3.36
	MgO	1.84
	CaO	29.30
	TiO ₂	1.58
15	K ₂ O	1.51
	Na ₂ O	2.64
	ZrO ₂	6.03

EXAMPLE 2

- 20 A raw material batch comprising 81.5 parts by weight of basalt "B", 18.5 parts by weight of hydrated lime and 6.7 parts by weight of zirconia was charged into an oil-fired furnace and melted. The molten glass flowed from the furnace chamber into a
25 forehearth and thence through metal bushings containing small holes. The streams of melt issuing from the small holes were attenuated into fibres by blowing with high pressure air.

- 30 The basalt "B" had the following composition, in weight percent:—

	SiO ₂	51.19
	Al ₂ O ₃	15.03
	Fe ₂ O ₃	3.88
35	FeO	6.90
	MgO	8.91
	CaO	7.52
	TiO ₂	1.77
	K ₂ O	1.71
40	Na ₂ O	3.09

- The glass produced had the following oxide composition in weight percent:—

45	SiO ₂	40.79
	Al ₂ O ₃	11.93
	Fe ₂ O ₃	5.00
	FeO	3.53
	MgO	7.08
50	CaO	20.03
	TiO ₂	1.41
	K ₂ O	1.34
	Na ₂ O	2.35
	ZrO ₂	6.54

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EXAMPLE 3

- The fibres in Examples 1 and 2 were used as reinforcement in a matrix containing ordinary Portland cement, from which building boards were produced.

60 CLAIMS

1. A glass composition comprising, by weight, 38 to 46% silica, 8 to 15% aluminium oxide, 15 to 30% calcium oxide, 1 to 8% zirconium oxide, 0 to 10% magnesium oxide, 4 to 11% iron as Fe₂O₃, and 2 to
65 6% R₂O, where R represents sodium, potassium or

lithium, the balance, if any, consisting of compatible constituents.

2. A composition as claimed in claim 1 comprising 20 to 30% calcium oxide and 5 to 8% zirconium oxide.

3. A composition as claimed in claim 1, as set forth in Example 1 or Example 2 hereinbefore.

4. Fibres of the composition claimed in any of claims 1 to 3.

- 75 5. A process for producing alkali-resistant glass fibres comprising forming a mixture containing basalt rock, a calcium-containing compound and a zirconium-containing compound, producing a melt from such mixture and blowing or spinning the melt
80 into fibres.

6. A process as claimed in claim 5 wherein the basalt is of the olivine type.

7. A process as claimed in claim 6 wherein the basalt is an olivine tholeiite or a teschenitic olivine
85 dolerite.

8. A process as claimed in any of claims 5 to 7 wherein the melt has a viscosity of 8 to 50 poises at 1400°C.

9. A process as claimed in claim 8 wherein the melt has a viscosity of 12 to 30 poises at 1400°C.

- 90 10. A process as claimed in claim 5, substantially as hereinbefore described in Example 1 or Example 2.

11. Glass fibres produced by a process as claimed in any of claims 5 to 10.

- 95 12. Shaped articles containing, as reinforcement, glass fibres as claimed in claim 4 or claim 11.

13. Shaped articles made from a mixture containing a calcium silicate binder, a gypsum plaster binder or a cement binder, and glass fibres as claimed
100 in claim 4 or claim 11.

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